MONOGRAPH SERIES

AMRA MS 64-05

PROPERTIES OF PIEZOELECTRIC MATERIALS

by

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JUNE 1964

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June 1964

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The purpose of this monograph is to provide a source of data on a wide variety of piezoelectric materials which will be useful to those conducting research in this area as well as to the engineer designing ultrasonic transducers, filters, and other piezoelectric devices.

The references are keyed to the data by the number heading each column of data. In some cases, the reference reports additional data not included in this monograph. The reader is therefore urged to consult the references before embarking upon a research program.

The numerical data are given in the rationalized MKS system in accordance with the IRE Standards on Piezoelectricity, as are the symbols employed. Table I defines the symbols employed and gives their MKS unit. Since a large amount of literature still uses the CGS system, Table II presents the factors to convert CGS units to MKS units. On the data pages, the digits in the data columns are to be multiplied by the power of ten in the column immediately to the right of the symbol to obtain the value in the MKS system.

The compounds are arranged alphabetically by chemical name. The pure compounds are followed by the binary alloys, followed by ternary compounds, etc. The multiple component compounds are arranged alphabetically by main constituent, secondary constituent, etc., and by decreasing amount of main constituent.

REFERENCE TEXTS

The following books and articles will provide a foundation of the theory of piezoelectricity and its many applications:

"A Textbook on Crystal Physics", W. A. Wooster, Cambridge University Press, 1938.

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TABLE I
Definition of Symbols

Symbol	Quantity	MKS Units*
c	Elastic Stiffness	N/m^2
d	Piezoelectric Strain Constant (Coefficient)	C/N or m/V
D	Electric Displacement	C/m^2
e	Piezoelectric Stress Constant (Moduli)	C/m^2
E	Electric Field Strength	V/m
g	Piezoelectric Strain Constant	m^2/C
h	Piezoelectric Stress Constant	N/C or V/m
k	Coupling Coefficient	
K	Dielectric Constant	N/C or V/M
P	Dielectric Polarization	C/m^2
Q	Mechanical Q	
s^{E**}	Elastic Compliance (E = constant)	m^2/N
S	Strain	
T	Stress (Tensile Positive)	n/m^2
u	Elastic Displacement	m
Y	Young's Modulus	N/m^2
β^T	Dielectric Impermeability (T = constant)	m/F
ϵ^T	Permittivity (T = constant)	F/m
η^S	Dielectric Susceptibility (S = constant)	
θ	Absolute Temperature	^oK
ρ	Density	kg/m^3
χ^T	Reciprocal Susceptibility (T = constant)	

* N = newton, m = meter, V = volt, C = coulomb, F = farad, ^oK = degrees kelvin, kg = kilogram

** Superscript denotes quantity which is held constant.

TABLE II
Conversion Factors from CGS to Rationalized MKS Units

Symbol	Factor	
c, T, Y	10^{-1}	N/m^2 per dyne/cm^2
d	$\frac{1}{3} \times 10^{-4}$	C/N per statcoulomb/dyne
D	$\frac{1}{12\pi \times 10^5}$	C/m^2 per statcoulomb/cm^2
e, P	$\frac{1}{3} \times 10^{-5}$	C/m^2 per statcoulomb/cm^2
E	3×10^4	V/m per statvolt/cm
g	3×10^5	m^2/C per dyne/statcoulomb
h	3×10^4	N/C per dyne/statcoulomb
s	10	m^2/N per cm^2/dyne
ϵ	$\frac{1}{36\pi \times 10^9}$	F/m per statfarad/cm
η	4π	(numeric)
ρ	10^3	kg/m^3 per gram/cm^3

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MATERIAL: Barium Titanate (Pure)

Property \ Reference		2	10	13	16	17	18	23
T_C	- -			108		130	115	115
K	- -			2300		1620	1700	1700
Y	$\times 10^{10}$	11					11	11
ρ	$\times 10^{3}$	5.7						5.8
c_{33}^{D}	$\times 10^{10}$		18.9					
d_{15}	$\times 10^{-12}$		270		392			
d_{31}	$\times 10^{-12}$	-78	-79	-97	-34.5	-50	-78	-78
d_{33}	$\times 10^{-12}$		191		85.6		190	190
ϵ_{33}^{T}	$\times \epsilon_o$		1900		168			
g_{31}	$\times 10^{-3}$	-5.2	-4.7		-23			
g_{33}	$\times 10^{-3}$		11.4		57.5			13.0
k_{15}	- -				0.57			
k_{31}	- -	0.214			0.315		0.22	0.22
k_{33}	- -				0.56		0.52	0.52
k_r	- -			0.37	0.37	0.20		0.37
s_{11}^{E}	$\times 10^{-12}$		8.55		8.05			
s_{12}^{E}	$\times 10^{-12}$		-2.61		-2.35			
s_{13}^{E}	$\times 10^{-12}$		-2.85		-5.24			
s_{33}^{E}	$\times 10^{-12}$		8.93		15.7			
s_{44}^{E}	$\times 10^{-12}$		23.3		18.4			
Q	- -						400	400

MATERIAL: Barium Titanate (Pure) Con't

Property		Reference 38	42	12	19			
T_C	- -		120					
K	- -	1700	1900					
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.7	5.72					
c_{33}^{D}	$\times 10^{10}$	17.6						
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-78		-56	-33			
d_{33}	$\times 10^{-12}$	190		130 to 160				
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$			10.7				
k_{15}	- -			0.41				
k_{31}	- -	0.21	0.21	0.17				
k_{33}	- -	0.50	0.49	0.45				
k_r	- -	0.36	0.35					
s_{11}^{E}	$\times 10^{-12}$	9.99			8.0			
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$	9.52						
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	400						

MATERIAL: Cadmium Sulphide (Annealed in Sulphur Vapor)

Property \ Reference		33	32					
T_C	- -							
K	- -	9.0						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$	-14.35						
d_{31}	$\times 10^{-12}$	-3.67	-1.53					
d_{33}	$\times 10^{-12}$	10.65	2.56					
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$	16						
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Ceramic A - (Brush Electronics)

Property \ Reference		11	12					
T_C	- -							
K	- -							
Y	$\times 10^{10}$		11.0					
ρ	$\times 10^{3}$	5.77						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$		-78					
d_{33}	$\times 10^{-12}$		190					
ϵ_{33}^{T}	$\times \epsilon_o$		1720					
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -		0.49					
k_{31}	- -		0.214					
k_{33}	- -		0.52					
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Ceramic B (Brush Electronics) (A Barium - Calcium Titanate)								
Property \ Reference		37						
T_C	- -	115						
K	- -	1200						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.5						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-58						
d_{33}	$\times 10^{-12}$	150						
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -	0.190						
k_{33}	- -	0.490						
k_r	- -	0.325						
s_{11}^{E}	$\times 10^{-12}$	8.62						
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$	9.0						
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	400						

MATERIAL: Lead Niobate

Property \ Reference		18	23	34				
T_C	- -	570	490	565				
K	- -	225	225	165				
Y	$\times 10^{10}$	3.5	3.5					
ρ	$\times 10^{3}$		5.9	5.5				
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-11	-11					
d_{33}	$\times 10^{-12}$	80	80					
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$		40					
k_{15}	- -							
k_{31}	- -	0.045	0.045					
k_{33}	- -	0.42	0.42	0.30				
k_r	- -	0.07	0.07					
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	11		5				

MATERIAL: Triglycine Sulphate (Pure)								
Property \ Reference		39	21	36	45			
T_C	- -	47						
Q	- -							
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$							
d_{23}	$\times 10^{-12}$	65	84	14				
d_{21}	$\times 10^{-12}$		22.7	5	30			
d_{22}	$\times 10^{-12}$		22	9.3				
d_{25}	$\times 10^{-12}$			2				
k_{21}	- -		0.18					
k_{22}	- -		0.18					
k_{23}	- -		0.44					
s_{11}^E	$\times 10^{-12}$			35.1	34			
s_{12}^E	$\times 10^{-12}$			-10.1				
s_{13}^E	$\times 10^{-12}$			-53.8				
s_{33}^E	$\times 10^{-12}$	82		86.0	87			
s_{44}^E	$\times 10^{-12}$			95.7				
s_{66}^E	$\times 10^{-12}$			164.9				

MATERIAL: Zinc Oxide (Pure with Lithium Dopant)

Property \ Reference		33						
T_C	- -							
K	- -	8.2						
Y	$x10^{10}$							
ρ	$x10^{3}$							
c_{33}^{D}	$x10^{10}$							
d_{15}	$x10^{-12}$	-13.3						
d_{31}	$x10^{-12}$	-4.67						
d_{33}	$x10^{-12}$	12.0						
ϵ_{33}^{T}	$x\epsilon_o$							
g_{31}	$x10^{-3}$							
g_{33}	$x10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -							
s_{11}^{E}	$x10^{-12}$							
s_{12}^{E}	$x10^{-12}$							
s_{13}^{E}	$x10^{-12}$							
s_{33}^{E}	$x10^{-12}$							
s_{44}^{E}	$x10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (95%) Barium Zirconate (5%)

Property \ Reference		42						
T_C	- -	105						
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.44						
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-60						
d_{33}	$\times 10^{-12}$	150						
ϵ_{33}^T	$\times \epsilon_o$	1400						
g_{31}	$\times 10^{-3}$	-4.8						
g_{33}	$\times 10^{-3}$	12.1						
k_{15}	- -	0.15						
k_{31}	- -	0.40						
k_{33}	- -	0.28						
k_r	- -							
s_{11}^E	$\times 10^{-12}$	11						
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -	200						

MATERIAL: Barium Niobate (60%) Lead Niobate (40%)

Property \ Reference		34	33					
T_C	- -	300	300					
K	- -	750	800					
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.6	5.6					
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$		-25					
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.16	0.16					
s_{11}^{E}	$\times 10^{-12}$		10.3					
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Niobate (50%) Lead Niobate (50%)

Property \ Reference		17	34	40				
T_C	- -	315	260	260				
K	- -	1205	1530	1550				
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$		5.6	5.6				
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-36.6		-58				
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.16	0.25	0.25				
s_{11}^{E}	$\times 10^{-12}$			10.1				
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (97%) Calcium Titanate (3%)

Property \ Reference		12						
T_C	- -							
K	- -							
Y	$\times 10^{10}$	12.2						
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-53						
d_{33}	$\times 10^{-12}$	135						
ϵ_{33}^{T}	$\times \epsilon_o$	1390						
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -	0.39						
k_{31}	- -	0.17						
k_{33}	- -	0.43						
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (95%) Calcium Titanate (5%)

Property		Reference 2	13	15	24			
T_C	- -		115	118	115			
K	- -	1190	1160	1320				
Y	$\times 10^{10}$	11.6		12.4				
ρ	$\times 10^{3}$	5.5		5.74	5.5			
c_{33}^{D}	$\times 10^{10}$				15.8			
d_{15}	$\times 10^{-12}$				257			
d_{31}	$\times 10^{-12}$	-58	-53	-61	-58			
d_{33}	$\times 10^{-12}$				150			
ϵ_{33}^{T}	$\times \epsilon_o$				1355			
g_{31}	$\times 10^{-3}$			-5.2	-5.5			
g_{33}	$\times 10^{-3}$							
k_{15}	- -				0.495			
k_{31}	- -	0.193			0.19			
k_{33}	- -				0.49			
k_r	- -		0.29	0.34	0.325			
s_{11}^{E}	$\times 10^{-12}$				8.7			
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$				9.0			
s_{44}^{E}	$\times 10^{-12}$				22.7			
Q	- -				500			

MATERIAL: Barium Titanate (96%) Lead Titanate (4%)

Property		Reference 12						
T_C	- -							
K	- -							
Y	$\times 10^{10}$	11.4						
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-38						
d_{33}	$\times 10^{-12}$	105						
ϵ_{33}^{T}	$\times \epsilon_o$	995						
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -	0.34						
k_{31}	- -	0.14						
k_{33}	- -	0.39						
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (95%) Lead Titanate (5%)								
Property \ Reference		2						
T_C	- -							
K	- -	1175						
Y	$\times 10^{10}$	11.0						
ρ	$\times 10^{3}$	5.7						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-53						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-5.1						
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -	0.172						
k_{33}	- -							
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (90%) Lead Titanate (10%)

Property \ Reference		18						
T_C	- -	150						
K	- -	500						
Y	$\times 10^{10}$	12						
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-23						
d_{33}	$\times 10^{-12}$	70						
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -	0.12						
k_{33}	- -	0.36						
k_r	- -	0.20						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	800						

MATERIAL: Barium Titanate (88%) Lead Titanate (12%)

Property		Reference 37						
T_C	- -	150						
K	- -	850						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.7						
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-30						
d_{33}	$\times 10^{-12}$	90						
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -	0.125						
k_{33}	- -	0.365						
k_r	- -	0.210						
s_{11}^E	$\times 10^{-12}$	7.82						
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$	8.13						
s_{44}^E	$\times 10^{-12}$							
Q	- -	1200						

MATERIAL: Ceramic A (95%) Calcium Titanate (5%)

Property \ Reference		12						
T_C	- -							
K	- -							
Y	$\times 10^{10}$	11.6						
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-58						
d_{33}	$\times 10^{-12}$	150						
ϵ_{33}^{T}	$\times \epsilon_o$	1185						
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -	0.193						
k_{33}	- -	0.50						
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead Hafnate (50%) Lead Titanate (50%)

Property		Reference 8						
T_C	- -	330						
K	- -	672						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	8.4						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-54						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-8.8						
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.38						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead Niobate (80%) Barium Niobate (20%)

Property		Reference 34	40					
T_C	- -	430	425					
K	- -	400	400					
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.9	5.9					
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$		25					
d_{33}	$\times 10^{-12}$							
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.20	0.20					
s_{11}^E	$\times 10^{-12}$		12.2					
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -	20	15					

MATERIAL: Lead Niobate (70%) Barium Niobate (30%)								
Property \ Reference		17	34	40	42			
T_C	- -	345	340	350	340			
K	- -	640	900	640				
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$			5.9	5.9			
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-36.6		-41	-40			
d_{33}	$\times 10^{-12}$				100			
ϵ_{33}^{T}	$\times \epsilon_o$				900			
g_{31}	$\times 10^{-3}$				-5.0			
g_{33}	$\times 10^{-3}$				12.5			
k_{15}	- -							
k_{31}	- -				0.13			
k_{33}	- -				0.33			
k_r	- -	0.19	0.24	0.24	0.24			
s_{11}^{E}	$\times 10^{-12}$			10.9	10.9			
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -		350	350	350			

MATERIAL: Lead Niobate (65%) Barium Niobate (35%)

Property		Reference 34	40					
T_C	- -	300	300					
K	- -	1020	1250					
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.9						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$		-60					
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.30	0.34					
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	400	330					

MATERIAL: Lead Niobate (60%) Barium Niobate (40%)

Property \ Reference		17	40	42	34			
T_C	- -	290	270	260				
K	- -	1190	1500		1600			
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$		5.9	5.9	5.9			
$\bar{c}_{33}$	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-56.6		-91	-90			
d_{33}	$\times 10^{-12}$				220			
ϵ_{33}^{T}	$\times \epsilon_o$				1500			
g_{31}	$\times 10^{-3}$				-6.8			
g_{33}	$\times 10^{-3}$				16.5			
k_{15}	- -							
k_{31}	- -				0.22			
k_{33}	- -				0.55			
k_r	- -	0.27	0.38	0.38	0.38			
s_{11}^{E}	$\times 10^{-12}$			11.5	11.5			
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead Niobate (55%) Barium Niobate (45%)

Property \ Reference		34	40					
T_C	- -	250	250					
K	- -	1620	1600					
Y	$x10^{10}$							
ρ	$x10^{3}$	5.8						
c_{33}^{D}	$x10^{10}$							
d_{15}	$x10^{-12}$							
d_{31}	$x10^{-12}$		-74					
d_{33}	$x10^{-12}$							
ϵ_{33}^{T}	$x\epsilon_o$							
g_{31}	$x10^{-3}$							
g_{33}	$x10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.35	0.37					
s_{11}^{E}	$x10^{-12}$							
s_{12}^{E}	$x10^{-12}$							
s_{13}^{E}	$x10^{-12}$							
s_{33}^{E}	$x10^{-12}$							
s_{44}^{E}	$x10^{-12}$							
Q	- -	230	260					

MATERIAL: Lead Niobate (90%) Barium Titanate (10%)

Property \ Reference		34	40					
T_C	- -	495	500					
K	- -	250	250					
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.6	5.6					
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$		-21					
d_{33}	$\times 10^{-12}$							
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -	0.3						
k_r	- -		0.20					
s_{11}^E	$\times 10^{-12}$		14.0					
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -	8	5					

MATERIAL: Lead Niobate (70%) Barium Titanate (30%)								
Property \ Reference		34						
T_C	- -	285						
K	- -	860						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.88						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$							
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.22						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	675						

MATERIAL: Lead Niobate (70%) Barium Zirconate (30%)

Property \ Reference		34						
T_C	- -	125						
K	- -	1820						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.94						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$							
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.10						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	56						

MATERIAL: Lead Niobate (70%) Cadmium Niobate (30%)

Property \ Reference		34	34					
T_C	- -	485	355					
K	- -	182	320					
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.55	5.60					
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$							
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead Niobate (70%) Niobium Oxide (30%)

Property		Reference 34						
T_C	- -	570						
K	- -	550						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.56						
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$							
d_{33}	$\times 10^{-12}$							
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.05						
s_{11}^E	$\times 10^{-12}$							
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -	575						

MATERIAL: Lead Niobate (90%) Strontium Niobate (10%)

Property \ Reference		34						
T_C	- -	600						
K	- -	212						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	5.60						
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$							
d_{33}	$\times 10^{-12}$							
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.12						
s_{11}^E	$\times 10^{-12}$							
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -	10						

MATERIAL: Lead Niobate (80%) Strontium Niobate (20%)

Property		Reference 17						
T_C	- -	450						
K	- -	440						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-43.3						
d_{33}	$\times 10^{-12}$							
ϵ_{33}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.26						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead Niobate (70%) Strontium Niobate (30%)

Property \ Reference		17	34					
T_C	- -	380	400					
K	- -	502	1030					
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$		5.65					
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-53.3						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.31	0.15					
s_{11}^E	$\times 10^{-12}$							
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -		38					

MATERIAL: Lead Niobate (60%) Strontium Niobate (40%)

Property		Reference 17						
T_C	- -	310						
K	- -	755						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-53.3						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.26						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead Niobate (55%) Strontium Niobate (45%)

Property		Reference 17						
T_C	- -	250						
K	- -	1060						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$							
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-50.0						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.22						
s_{11}^E	$\times 10^{-12}$							
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead-Tin Oxide (60%) Lead Titanate (40%)

Property		Reference 8						
T_C	- -	225						
K	- -	776						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	8.2						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-28						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-5.0						
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.20						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead-Tin Oxide (55%) Lead Titanate (45%)

Property \ Reference		8						
T_C	- -	235						
K	- -	1260						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	8.0						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-46						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-5.1						
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.25						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead Titanate (52%) Lead Zirconate (48%)

Property \ Reference		29						
T_C	- -							
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.9						
c_{33}^D	$\times 10^{10}$	14.0						
d_{15}	$\times 10^{-12}$	166						
d_{31}	$\times 10^{-12}$	-43.0						
d_{33}	$\times 10^{-12}$	110						
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-7.3						
g_{33}	$\times 10^{-3}$	18.7						
k_{15}	- -	0.408						
k_{31}	- -	0.170						
k_{33}	- -	0.435						
k_r	- -	0.289						
s_{11}^E	$\times 10^{-12}$	10.8						
s_{12}^E	$\times 10^{-12}$	-3.35						
s_{13}^E	$\times 10^{-12}$	-3.21						
s_{33}^E	$\times 10^{-12}$	10.9						
s_{44}^E	$\times 10^{-12}$	28.3						
Q	- -	1170						

MATERIAL: Lead Titanate (50%) Lead Zirconate (50%)

Property \ Reference		8	29					
T_C	- -	400						
K	-	641						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.1	7.55					
c_{33}^D	$\times 10^{10}$		13.5					
d_{15}	$\times 10^{-12}$		166					
d_{31}	$\times 10^{-12}$		-43.0					
d_{33}	$\times 10^{-12}$		110					
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$		-9.35					
g_{33}	$\times 10^{-3}$		23.1					
k_{15}	- -		0.504					
k_{31}	- -		0.230					
k_{33}	- -		0.546					
k_r	- -		0.397					
s_{11}^E	$\times 10^{-12}$		12.4					
s_{12}^E	$\times 10^{-12}$		-3.35					
s_{13}^E	$\times 10^{-12}$		-4.22					
s_{33}^E	$\times 10^{-12}$		13.3					
s_{44}^E	$\times 10^{-12}$		32.8					
Q	- -		950					

MATERIAL: PZT-4 (Lead Titanate - Lead Zirconate)
(Clevite Corp.)

Property \ Reference		18	24	37	2			
T_C	- -	340	340	328				
K	- -	1200		1350	1200			
Y	$\times 10^{10}$	8.1			8.15			
ρ	$\times 10^{3}$		7.5	7.5				
c_{33}^{D}	$\times 10^{10}$		15. .					
d_{15}	$\times 10^{-12}$		256					
d_{31}	$\times 10^{-12}$	-105	-111	-117	-131			
d_{33}	$\times 10^{-12}$	250	450	270				
ϵ_{33}^{T}	$\times \epsilon_o$		1885					
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -		0.65					
k_{31}	- -	0.29	^ 31	0.31				
k_{33}	- -	0.63	0.64	0.64				
k_r	- -	0.50	0.52					
s_{11}^{E}	$\times 10^{-12}$		12.3	11.8				
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$		14.9	14.9				
s_{44}^{E}	$\times 10^{-12}$		38.4					
Q	- -	600	600	500				

MATERIAL: PZT-5 (Lead Titanate - Lead Zirconate) (Clevite Corp.)

Property		Reference '4	25	37				
T_C	- -	360		365				
K	- -		1500	1500				
Y	$\times 10^{10}$		6.75					
ρ	$\times 10^{3}$	7.5		7.55				
c_{33}^{D}	$\times 10^{10}$	13.5						
d_{15}	$\times 10^{-12}$	495						
d_{31}	$\times 10^{-12}$	-140		-140				
d_{33}	$\times 10^{-12}$	320		320				
ϵ^{T}	$\times \epsilon_o$	1690						
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -	0.655						
k_{31}	- -	0.32		0.32				
k_{33}	- -	0.675		0.675				
k_r	- -	0.54						
s_{11}^{E}	$\times 10^{-12}$	14.8		14.8				
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$	17.1		17.1				
s_{44}^{E}	$\times 10^{-12}$	50						
Q	- -	75						

MATERIAL: Lead Zirconate (53%) Lead Titanate (47%)

Property \ Reference		20						
T_C	- -	385						
K	- -	542						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.40						
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-71						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-14.7						
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.48						
s_{11}^E	$\times 10^{-12}$							
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -							

MATERIAL: Lead Zirconate (60%) Lead Titanate (40%)

Property \ Reference		8	29					
T_C	- -	350						
K	- -	524						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.3	7.60					
c_{33}^D	$\times 10^{10}$		18.9					
d_{15}	$\times 10^{-12}$		293					
d_{31}	$\times 10^{-12}$		-44.2					
d_{33}	$\times 10^{-12}$		117					
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$		-13.3					
g_{33}	$\times 10^{-3}$		35.2					
k_{15}	- -		0.625					
k_{31}	- -		0.238					
k_{33}	- -		0.585					
k_r	- -		0.400					
s_{11}^E	$\times 10^{-12}$		10.4					
s_{12}^E	$\times 10^{-12}$		-2.96					
s_{13}^E	$\times 10^{-12}$		-3.72					
s_{33}^E	$\times 10^{-12}$		12.05					
s_{44}^E	$\times 10^{-12}$		36.9					
Q	- -		430					

MATERIAL: Lead Zirconate (58%) Lead Titanate (42%)

Property \ Reference		29						
T_C	- -							
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.64						
c_{33}^{D}	$\times 10^{10}$	15.8						
d_{15}	$\times 10^{-12}$	325						
d_{31}	$\times 10^{-12}$	-48.9						
d_{33}	$\times 10^{-12}$	129						
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-13.9						
g_{33}	$\times 10^{-3}$	36.1						
k_{15}	- -	0.646						
k_{31}	- -	0.254						
k_{33}	- -	0.607						
k_r	- -	0.428						
s_{11}^{E}	$\times 10^{-12}$	10.5						
s_{12}^{E}	$\times 10^{-12}$	-3.07						
s_{13}^{E}	$\times 10^{-12}$	-4.12						
s_{33}^{E}	$\times 10^{-12}$	12.8						
s_{44}^{E}	$\times 10^{-12}$	37.7						
Q	- -	500						

MATERIAL: Lead Zirconate (56%) Lead Titanate (44%)

Property \ Reference		29						
T_C	- -							
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.59						
c_{33}^D	$\times 10^{10}$	15.3						
d_{15}	$\times 10^{-12}$	357						
d_{31}	$\times 10^{-12}$	-54.3						
d_{33}	$\times 10^{-12}$	142						
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-14.5						
g_{33}	$\times 10^{-3}$	37.8						
k_{15}	- -	0.657						
k_{31}	- -	0.267						
k_{33}	- -	0.619						
k_r	- -	0.450						
s_{11}^E	$\times 10^{-12}$	11.0						
s_{12}^E	$\times 10^{-12}$	-3.22						
s_{13}^E	$\times 10^{-12}$	-4.63						
s_{33}^E	$\times 10^{-12}$	14.0						
s_{44}^E	$\times 10^{-12}$	39.8						
Q	- -	490						

MATERIAL: Lead Zirconate (55%) Lead Titanate (45%)

Property		Reference 4	8	18				
T_C	- -		330	350				
K	- -	585	606	500				
Y	$\times 10^{10}$	7.5		7 5				
ρ	$\times 10^{3}$	7.1	7.2					
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-50	-56	-56				
d_{33}	$\times 10^{-12}$	130		130				
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-11.0	-11.7					
g_{33}	$\times 10^{-3}$	29						
k_{15}	- -							
k_{31}	- -	0.22		0.23				
k_{33}	- -	0.5 to 0.6		0.55				
k_r	- -	0.37	0.36	0.39				
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -			300				

MATERIAL: Lead Zirconate (54%) Lead Titanate (46%)								
Property \ Reference		26	29					
T_C	- -	390						
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.41	7.62					
c_{33}^D	$\times 10^{10}$		14.8					
d_{15}	$\times 10^{-12}$		440					
d_{31}	$\times 10^{-12}$	-71	-60.2					
d_{33}	$\times 10^{-12}$		152					
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$		-15.1					
g_{33}	$\times 10^{-3}$		38.1					
k_{15}	- -		0.701					
k_{31}	- -		0.280					
k_{33}	- -		0.626					
k_r	- -	0.49	0.470					
s_{11}^E	$\times 10^{-12}$		11.6					
s_{12}^E	$\times 10^{-12}$		-3.33					
s_{13}^E	$\times 10^{-12}$		-4.97					
s_{33}^E	$\times 10^{-12}$		14.8					
s_{44}^E	$\times 10^{-12}$		45.0					
Q	- -		680					

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MATERIAL: Lead Zirconate (52%) Lead Titanate (48%)

Property \ Reference		29	42					
T_C	- -		370					
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.55						
c_{33}^D	$\times 10^{10}$	13.4						
d_{15}	$\times 10^{-12}$	494						
d_{31}	$\times 10^{-12}$	-93.5						
d_{33}	$\times 10^{-12}$	223						
ϵ_{33}^T	$\times \epsilon_o$	730	730					
g_{31}	$\times 10^{-3}$	-14.5						
g_{33}	$\times 10^{-3}$	34.5						
k_{15}	- -	0.694						
k_{31}	- -	0.313						
k_{33}	- -	0.670						
k_r	- -	0.529						
s_{11}^E	$\times 10^{-12}$	13.8						
s_{12}^E	$\times 10^{-12}$	-4.07						
s_{13}^E	$\times 10^{-12}$	-5.80						
s_{33}^E	$\times 10^{-12}$	17.1						
s_{44}^E	$\times 10^{-12}$	48.2						
Q	- -	860						

MATERIAL: LZ-4A (Lead Zirconate - Lead Titanate)
(Brush Electronics)

Property \ Reference		38	42					
T_C	- -		320					
K	- -	1200						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.6						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-130						
d_{33}	$\times 10^{-12}$	300						
ϵ_{33}^{T}	$\times \epsilon_o$		1200					
g_{31}	$\times 10^{-3}$		-12.3					
g_{33}	$\times 10^{-3}$		28.3					
k_{15}	- -							
k_{31}	- -	0.30						
k_{33}	- -	0.76						
k_r	- -	0.55						
s_{11}^{E}	$\times 10^{-12}$	14.6						
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$	14.8						
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	500						

MATERIAL: LZ-5A (Lead Zirconate - Lead Titanate) (Brush Electronics)								
Property \ Reference		38	42					
T_C	- -		350					
K	- -	1500						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.5						
c_{33}^{D}	$\times 10^{10}$	13.5						
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-140						
d_{33}	$\times 10^{-12}$	320						
ϵ_{33}^{T}	$\times \epsilon_o$		1500					
g_{31}	$\times 10^{-3}$		-10.6					
g_{33}	$\times 10^{-3}$		24.4					
k_{15}	- -							
k_{31}	- -	0.32	0.32					
k_{33}	- -	0.68	0.68					
k_r	- -	0.54	0.54					
s_{11}^{E}	$\times 10^{-12}$	14.7	14.8					
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$	16.9						
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	75						

MATERIAL: LZ-6 (Lead Zirconate - Lead Titanate) (Brush Electronics)								
Property \ Reference		38						
T_C	- -							
K	- -	1075						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	7.5						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-78						
d_{33}	$\times 10^{-12}$	191						
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -	0.229						
k_{33}	- -	0.54						
k_r	- -	0.39						
s_{11}^{E}	$\times 10^{-12}$	11.5						
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	340						

MATERIAL: Potassium Niobate (50%) Sodium Niobate (50%)

Property \ Reference		23						
T_C	- -	410						
K	- -	294						
Y	$\times 10^{10}$	10.4						
ρ	$\times 10^{3}$	4.3						
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-32						
d_{33}	$\times 10^{-12}$	80						
ϵ_{33}^T	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$	32						
k_{15}	- -							
k_{31}	- -	0.21						
k_{33}	- -	0.51						
k_r	- -	0.34						
s_{11}^E	$\times 10^{-12}$							
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -	140						

MATERIAL: Sodium Niobate (95%) Cadmium Niobate (5%)

Property \ Reference		40						
T_C	- -	375						
K	- -	600						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	4.2						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-6						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.04						
s_{11}^{E}	$\times 10^{-12}$	11.9						
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Sodium Niobate (90%) Cadmium Niobate (10%)

Property \ Reference		40						
T_C	- -	330						
K	- -	950						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	4.3						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-22						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.11						
s_{11}^{E}	$\times 10^{-12}$	11.6						
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Sodium Niobate (89%) Cadmium Niobate (11%)

Property \ Reference		18						
T_C	- -	220						
K	- -	2000						
Y	$\times 10^{10}$	11						
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	70						
d_{33}	$\times 10^{-12}$	175						
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -	0.18						
k_{33}	- -							
k_r	- -	0.30						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	300						

MATERIAL: Sodium Niobate (85%) Cadmium Niobate (15%)

Property \ Reference		40						
T_C	- -	285						
K	- -	1350						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	4.3						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-40						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.18						
s_{11}^{E}	$\times 10^{-12}$	11.6						
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Sodium Niobate (80%) Cadmium Niobate (20%)

Property \ Reference		40	42					
T_C	- -	240	240					
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	4.3	4.3					
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$		-80					
d_{33}	$\times 10^{-12}$		200					
ϵ_{33}^T	$\times \epsilon_o$		2000					
g_{31}	$\times 10^{-3}$		-4.5					
g_{33}	$\times 10^{-3}$		8.5					
k_{15}	- -							
k_{31}	- -		0.17					
k_{33}	- -		0.42					
k_r	- -		0.30					
s_{11}^E	$\times 10^{-12}$		10.5					
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -							

MATERIAL: Sodium Niobate (75%) Cadmium Niobate (25%)

Property \ Reference		40	42					
T_C	- -	200	200					
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	4.4	4.4					
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-60	-60					
d_{33}	$\times 10^{-12}$		150					
ϵ_{33}^T	$\times \epsilon_o$		2000					
g_{31}	$\times 10^{-3}$		-3.4					
g_{33}	$\times 10^{-3}$		8.5					
k_{15}	- -							
k_{31}	- -		0.14					
k_{33}	- -		0.35					
k_r	- -	0.26	0.26					
s_{11}^E	$\times 10^{-12}$	9.0	9.0					
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -							

MATERIAL: Sodium Niobate (70%) Cadmium Niobate (30%)

Property \ Reference		40						
T_C	- -	155						
K	- -	2500						
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$	4.2						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-66						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.24						
s_{11}^{E}	$\times 10^{-12}$	10.1						
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (95%) Calcium Titanate (5%) Cobalt Carbonate (0.25%)								
Property \ Reference		13	15					
T_C	- -	112	111					
K	- -	1110	1270					
Y	$\times 10^{10}$		11.6					
ρ	$\times 10^{3}$		5.61					
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-51	-60					
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$		-5.3					
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.30	0.33					
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (95%) Calcium Titanate (5%) Cobalt Carbonate (0.5%)								
Property \ Reference		13	15					
T_C	- -	108	110					
K	- -	1200	1340					
Y	$\times 10^{10}$		12.2					
ρ	$\times 10^{3}$		5.64					
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-50	-59					
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$		-5.0					
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.29	0.32					
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (95%) Calcium Titanate (5%) Cobalt Carbonate (0.75%)								
Property \ Reference		13	15	24				
T_C	- -	106	105	105				
K	- -	1100	1420					
Y	$x10^{10}$		12.4					
ρ	$x10^{3}$		5.69	5.7				
c_{33}^{D}	$x10^{10}$							
d_{15}	$x10^{-12}$							
d_{31}	$x10^{-12}$	-45	-59	-59				
d_{33}	$x10^{-12}$							
ϵ_{33}^{T}	$x\epsilon_o$			1605				
g_{31}	$x10^{-3}$		-4.7					
g_{33}	$x10^{-3}$							
k_{15}	- -							
k_{31}	- -			0.182				
k_{33}	- -							
k_r	- -	0.27	0.31	0.31				
s_{11}^{E}	$x10^{-12}$			8.06				
s_{12}^{E}	$x10^{-12}$							
s_{13}^{E}	$x10^{-12}$							
s_{33}^{E}	$x10^{-12}$							
s_{44}^{E}	$x10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (95%) Calcium Titanate (5%) Cobalt Carbonate (1.0%)								
Property \ Reference		13	15					
T_C	- -	105	104					
K	- -	1160						
Y	$x10^{10}$		11.8					
ρ	$x10^{3}$		5.73					
c_{33}^{D}	$x10^{10}$							
d_{15}	$x10^{-12}$							
d_{31}	$x10^{-12}$	-45	-56					
d_{33}	$x10^{-12}$							
ϵ_{33}^{T}	$x\epsilon_o$							
g_{31}	$x10^{-3}$		-4.3					
g_{33}	$x10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.27	0.28					
s_{11}^{E}	$x10^{-12}$							
s_{12}^{E}	$x10^{-12}$							
s_{13}^{E}	$x10^{-12}$							
s_{33}^{E}	$x10^{-12}$							
s_{44}^{E}	$x10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (95%) Calcium Titanate (5%) Cobalt Carbonate (1.25%)								
Property \ Reference		15						
T_C	- -	100						
K	- -	1500						
Y	$\times 10^{10}$	12.9						
ρ	$\times 10^{3}$	5.70						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-56						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-4.1						
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.29						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (95%) Calcium Titanate (5%)
Cobalt Carbonate (1.5%)

Property \ Reference		15						
T_C	- -	100						
K	- -	1500						
Y	$\times 10^{10}$	11.6						
ρ	$\times 10^{3}$	5.71						
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-59						
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$	-4.4						
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -	0.29						
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (90%) Calcium Titanate (6%) Lead Titanate (4%)								
Property \ Reference		12						
T_C	- -							
K	- -							
Y	$\times 10^{10}$	12.4						
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-40						
d_{33}	$\times 10^{-12}$	115						
ϵ_{33}^{T}	$\times \epsilon_o$	800						
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -	0.43						
k_{31}	- -	0.167						
k_{33}	- -	0.48						
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL: Barium Titanate (84%) Calcium Titanate (8%) Lead Titanate (8%)								
Property \ Reference		7	12					
T_C	- -							
K	- -							
Y	$\times 10^{10}$		13.1					
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-22.2	-27					
d_{33}	$\times 10^{-12}$		80					
ϵ_{33}^{T}	$\times \epsilon_o$	498	600					
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -		0.35					
k_{31}	- -		0.124					
k_{33}	- -		0.4					
k_r	- -	0.208						
s_{11}^{E}	$\times 10^{-12}$	7.32						
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	1090						

MATERIAL: Barium Titanate (80%) Calcium Titanate (12%) Lead Titanate (8%)								
Property \ Reference		7	42					
T_C	- -		160					
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$		5.3					
c_{33}^D	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-17.9	-35					
d_{33}	$\times 10^{-12}$		90					
ϵ_{33}^T	$\times \epsilon_o$	417	600					
g_{31}	$\times 10^{-3}$		-7.3					
g_{33}	$\times 10^{-3}$		18					
k_{15}	- -							
k_{31}	- -		0.12					
k_{33}	- -		0.30					
k_r	- -	0.184	0.22					
s_{11}^E	$\times 10^{-12}$	7.522	13					
s_{12}^E	$\times 10^{-12}$							
s_{13}^E	$\times 10^{-12}$							
s_{33}^E	$\times 10^{-12}$							
s_{44}^E	$\times 10^{-12}$							
Q	- -	1185	350					

MATERIAL: Barium Titanate (80%) Lead Titanate (12%) Calcium Titanate (8%)

Property		Reference 23	24	12				
T_C	- -	145	140					
K	- -	500						
Y	$\times 10^{10}$	11.9		12.8				
ρ	$\times 10^{3}$	5.4	5.4					
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$	-31		-20				
d_{33}	$\times 10^{-12}$	79		60				
ϵ_{33}^{T}	$\times \epsilon_o$			400				
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$	18						
k_{15}	- -			0.30				
k_{31}	- -	0.15		0.113				
k_{33}	- -	0.41		0.34				
k_r	- -	0.24	0.19					
s_{11}^{E}	$\times 10^{-12}$	7.8						
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -	600	1200					

MATERIAL:								
Property \ Reference								
T_C	- -							
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$							
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

MATERIAL :								
Property \ Reference								
T_C	- -							
K	- -							
Y	$\times 10^{10}$							
ρ	$\times 10^{3}$							
c_{33}^{D}	$\times 10^{10}$							
d_{15}	$\times 10^{-12}$							
d_{31}	$\times 10^{-12}$							
d_{33}	$\times 10^{-12}$							
ϵ_{33}^{T}	$\times \epsilon_o$							
g_{31}	$\times 10^{-3}$							
g_{33}	$\times 10^{-3}$							
k_{15}	- -							
k_{31}	- -							
k_{33}	- -							
k_r	- -							
s_{11}^{E}	$\times 10^{-12}$							
s_{12}^{E}	$\times 10^{-12}$							
s_{13}^{E}	$\times 10^{-12}$							
s_{33}^{E}	$\times 10^{-12}$							
s_{44}^{E}	$\times 10^{-12}$							
Q	- -							

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